USGS

WATER RESOURCES RESEARCH GRANT PROPOSAL

Project ID: 2005CA124B

Title: Estuarine Landscape Modeling of Suisun Bay

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Keywords: Hydrology, Climatology, Hydraulics, Estuarine, Landscape Modeling, Suisun Bay

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Abstract

California's delicate balance between water supply and ecosystem preservation is under increasing pressure from a growing population and habitat loss. The locus of many of these issues is San Francisco Bay, where freshwater from the Sacramento/San Joaquin Delta meets saline water from the Pacific Ocean. Suisun Bay is the furthest landward subembayment of San Francisco Bay, and is therefore most responsive to freshwater flow. Water withdrawals from the Delta adversely impact the estuarine ecosystem and habitats. Increasing the quality of habitat in Suisun Bay, however, would decrease the ecosystem stress caused by freshwater flow diversions. Current goals of ecosystem restoration include the creation and maintenance of beneficial wetlands and shallow-water habitat (Goals Project 1999).

Geomorphic evolution of estuarine habitats and landscapes over decadal timescales (>10 years) is sensitive to sediment supply from the watershed as well as estuarine hydrodynamics. Sediment supply to the Bay is an ongoing issue, beginning with the drastic input of sediment during the hydraulic mining period of the late 19th century

(Gilbert 1917). Today sediment supply is declining due to reduction of the hydraulic mining sediment pulse, reservoir storage, and land use practices (Wright and Schoellhamer in press). Future climate change, land use change, and sea level rise are some of the many factors that may alter sediment supply and threaten ecologically beneficial estuarine habitats (Scavia et al. 2002, Pont et al. 2002). Hydrodynamics are directly modulated by the varying morphology of the Bay (and vice-versa), so there is a feedback between hydrodynamics and geomorphology.

We propose to develop a computational model to study the estuarine landscape of Suisun Bay. The motivation is to provide the wider scientific community with a reliable predictive tool that ultimately would be used to create scenarios of geomorphic evolution of Suisun Bay for given scenarios of changes in climate, land use, and water resource management. Our approach is similar to that used by Hibma et al. (2003) for an idealized estuary. Tidal time scale hydrodynamics and sediment transport would be calculated with the public domain Regional Oceanic Modeling System (ROMS) model which has already been applied to Suisun Bay (Warner et al. in press). The calculated tidally-averaged sediment flux would be used to determine geomorphologic change in Suisun Bay over a period of several months or years. The tidal time scale model would be rerun with new bathymetry. An iterative process would be used to simulate geomorphic change over decades. Historical bathymetric data for Suisun Bay (Cappiella et al. 1999) would be used to calibrate and validate the model. Important procedural questions we will address include the level of sophistication needed for the tidal time scale model, the choice of the sediment transport function, and the iteration strategy. The resulting tool will assist resource agencies, such as the California State Coastal Conservancy and California Bay-Delta Authority, which are responsible for planning and implementing ecosystem restoration.